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Combination of chlorine and fluorine: surface cleaning and inorganic impurity elimination from detonation nanodiamonds by a selective gas phase purification method

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Detonation nanodiamonds are sp^3 carbon nanomaterials with narrow diameter distribution. They have high potential of application in various fields like nanomedicine, advanced composites and lubricants, photocatalysis. Detonation nanodiamonds unfortunately contain metallic and inorganic impurities of diverse nature which can act as “Trojan horses” and even at weak content, they can significantly impact the nanodiamonds efficiency and the searched performances. At the state of traces, the detection, quantification as well as the subsequent removal of these impurities are highly difficult since their content is under the limit of detection of most of the characterization techniques available by scholars in material science laboratories. In this paper, two important results will be revealed and discussed from our recent research on detonation nanodiamonds. The first one is a simple and smart method to detect and identify the inorganic impurities in detonation nanodiamonds we have developed [1]. Our approach which

consists of a selective combustion of the nanodiamonds results in concentrating these impurities allowing their facile investigation. This approach, transferable to other kinds of carbon nanomaterials, is proved to be a valuable way allowing analysis of detonation nanodiamonds by standard characterization techniques. The second part of our paper will be devoted to the selective elimination of metal impurities from detonation nanodiamonds. By concentrating the remaining impurities subsequent to the applied treatments by our developed approach, we could optimize the experimental conditions for a sequential gas phase purification method. In particular, we will show that combination of chlorine and fluorine gases, allow an unprecedented efficient method for eliminating both the surface functional groups and the inorganic impurities from nanodiamonds.

Reference

- [1] K. Henry, M. Emo, S. Diliberto, S. Hupont, J.-C. Arnault, H. Girard, M. Dubois, B. Vigolo, Facile characterization of metallic impurities in detonation nanodiamonds through selective combustion using standard techniques, *Diamond and Related Materials* 140 (2023) 110466. <https://doi.org/10.1016/j.diamond.2023.110466>.